IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of
Daines-Martinez et al.

Serial No.: 10/577,753

Filed: April 27, 2006

For: Installation and Method for the Purification of an Aqueous Effluent by Means of Oxidation and Membrane Filtration

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Patent Pending

Examiner: Mr. Lucas A. Stelling

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APPEAL BRIEF

(I.) REAL PARTY IN INTEREST

The real party in interest is OTV S.A.

(II.) RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

(III.) STATUS OF CLAIMS

The claims on appeal are claims 28, 29, 31-38, 40, 41, 44-49, 55, 57 and 59-70. Claims 1-27, 30, 39, 42, 43, 50-54, 56 and 58 have been canceled.

(IV.) STATUS OF AMENDMENTS

All amendments have been entered.

(V.) SUMMARY OF CLAIMED SUBJECT MATTER

Claim 65 is directed toward a method of treating an aqueous influent containing organic matter. An oxidizing gas is injected into a bottom portion of a vertical oriented column reactor 1. p. 11, lines 19-22, Fig. 1. A bed of catalyst material 3 is suspended in the column reactor 1 to form a fluidized bed of catalyst material 3 in the reactor 1. p. 11, lines 19-22, Fig. 1. At least a portion of the fluidized bed 3 is disposed in the lower portion of the column reactor 1. p. 11, lines 19-22, Fig. 1. The oxidizing gas injected into the column reactor 1 functions to suspend the bed of catalyst material 3 in the reactor 1. p. 6, lines 15-18, Fig. 1. Influent is injected into the bottom portion of the

column reactor 1 where the influent is contacted with the oxidizing gas in the presence of the fluidized bed of catalyst material 3 that promotes the oxidation reaction of organic material in the influent or promotes the adsorption of organic material by the bed of catalyst material 3 thereby yielding treated water. p. 5, lines 9-11; p. 6, lines 12-14; p. 11, lines 13-15; Fig. 1. The column reactor 1 includes an immersed membrane filtration unit 4 disposed in the upper portion of the column reactor 1 and where in at least a portion of the fluidized bed of catalyst material 3 is maintained below the membrane filtration unit 4 in the column reactor 1. p. 11, line 25 through p. 12, line 2, Fig. 1. After the influent is directed through the fluidized bed of catalyst material 3 and directed through the oxidizing gas in the lower portion of the column reactor 1, at least a first portion of the treated water is filtered in the immersed membrane filtration unit 4 disposed in the upper portion of the column reactor 1 forming a filtered influent. p. 11, line 25 through p. 12, line 2, Fig. 1. The filtered influent is directed from the reactor 1. p. 11, lines 13-15, Fig. 1. At least a second portion of the treated water bypasses the immersed membrane filtration unit 4 such that the second portion of the treated water is non-permeated treated water. p. 13, lines 17-21, Fig. 1. At least a portion of the non-permeated treated water is recirculated from the upper portion of the column reactor, through a recirculation line 7 that lies outside of the column reactor 1 and back into the lower portion of the column reactor 1. p. 13, lines 17-21, Fig. 1. At least a portion of the oxidizing gas is recirculated from the upper portion of the column reactor, through a gas recirculation loop 6 disposed outside of the column reactor, and back into the lower portion of the column reactor 1. p. 11, lines 13-18, Fig. 1.

Claim 70 is directed to a system for oxidizing and filtering an aqueous influent containing organic matter. The system includes a single chamber column reactor 1 oriented in a vertical configuration and having a bottom portion and an upper portion. p. 11, lines 13-14, Fig. 1. An influent inlet 9 is formed in the bottom portion of the column reactor 1 for permitting the influent to enter the bottom portion of the column reactor 1. p. 11, lines 13-15, Fig. 1. A fluid bed of catalyst material 3 is disposed in the column reactor 1 and a substantial portion of the fluid bed of catalyst material 3 is disposed in the lower portion of the column reactor 1. p. 11, lines 19-22, Fig. 1. An oxidizing gas inlet 2 is formed in the bottom portion of the column reactor 1 for injecting an oxidizing gas into the bottom portion of the column reactor 1 and for oxidizing the organic material in the influent and for suspending the catalyst material 3 in the column reactor 1 and forming the fluidized bed of catalyst material 3. p. 6, lines 12-14; p. 11, lines 19-22, Fig. 1. The system also includes a membrane filtration unit 4 for filtering the treated influent and producing a filtered influent. p. 11, lines 23-24, Fig. 1. The membrane filtration unit 4 is disposed in the upper portion of a column reactor 1 over a substantial portion of the fluidized bed 3 such that the influent injected into the bottom of the column reactor 1 moves upward through the fluidized bed 3 and is treated therein prior to reaching the membrane filtration unit 4. p. 11, line 25 through p. 12, line 2, Fig. 1. A recirculation line 7 extends exteriorly of the reactor for directing a non-permeated treated water stream from the upper portion of the column reactor 1 into a bottom portion of a column reactor 1 such that the recirculation line 7 is operative to transfer non-permeated treated water from the upper portion of the column reactor 1, through the exterior recirculation line 7 and into the bottom portion of the column reactor 1. p.

13, lines 17-21, Fig. 1. An oxidizing gas recirculation line 6 extends exteriorly of a column reactor 1 for transferring oxidizing gas from the upper portion of the column reactor 1, through the exterior recirculation line 6 and into the bottom portion of the column reactor 1. p. 11, lines 13-18, Fig. 1.

(VI.) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Whether claims 28, 31, 33, 34, 38, 40, 44-49, 59, 64-68 and 70 are obvious under 35 U.S.C. §103 in view of U.S. Patent No. 4,137,162 to Mohri, et al., in view of U.S. Patent No. 5,407,644 to Rytter, et al., in view of U.S. Patent No. 5,607,593 to Cote, in view of U.S. Patent No. 4,589,927 to Allen, et al., and finally in view of U.S. Patent No. 4,076,617 to Bybel.

(VII.) ARGUMENT

A. Claims 28, 31, 33, 34, 38, 40-49, 59, 64-68 and 70 are Not Obvious Over the Combined Teachings of the Patents to Mohri, Rytter, Cote, Allen, and Bybel.

Claim 65 is as follows:

> A method of treating an aqueous influent containing organic matter, the method comprising:
>
> a. injecting an oxidizing gas into a bottom portion of a vertical oriented column reactor;
> b. suspending a bed of catalyst material in the column reactor to form a fluidized bed of catalyst material in the reactor wherein at least a portion of the fluidized bed is disposed in the lower portion of the column reactor;
> c. wherein the oxidizing gas injected into the column reactor functions to suspend the bed of catalyst material in the reactor;

d. injecting the influent to be treated into the bottom portion of the column reactor where the influent is contacted with the oxidizing gas in the presence of the fluidized bed of catalyst material that promotes the oxidation reaction of organic material in the influent or promotes the adsorption of organic material by the bed of catalyst material thereby yielding treated water;
e. wherein the column reactor includes an immersed membrane filtration unit disposed in the upper portion of the column reactor and where in at least a portion of the fluidized bed of catalyst material is maintained below the membrane filtration unit in the column reactor;
f. after directing the influent through the fluidized bed of catalyst material and oxidizing gas in the lower portion of the column reactor, filtering at least a first portion of the treated water in the immersed membrane filtration unit disposed in the upper portion of the column reactor forming a filtered influent;
g. directing the filtered influent from the reactor;
h. bypassing the immersed membrane filtration unit with at least a second portion of the treated water such that the second portion of the treated water is non-permeated treated water;
i. recirculating at least a portion of the non-permeated treated water from the upper portion of the column reactor, through a recirculation line that lies outside of the column reactor and back into the lower portion of the column reactor; and
j. recirculating at least a portion of the oxidizing gas from the upper portion of the column reactor, through a gas recirculation loop disposed outside of the column reactor and back into the lower portion of the column reactor.

Claim 70 is as follows:

A system for oxidizing and filtering an aqueous influent containing organic matter, the system in operation comprising:

a. a single chamber column reactor oriented in a vertical configuration and having a bottom portion and an upper portion;
b. an influent inlet formed in the bottom portion of the column reactor for permitting the influent to enter the bottom portion of the column reactor;

c. a fluid bed of catalyst material disposed in the column reactor and wherein a substantial portion of the fluid bed of catalyst material is disposed in the lower portion of the column reactor;
d. an oxidizing gas inlet formed in the bottom portion of the column reactor for injecting an oxidizing gas into the bottom portion of the column reactor and for oxidizing the organic material in the influent and for suspending the catalyst material in the column reactor and forming the fluidized bed of catalyst material;
e. a membrane filtration unit for filtering the treated influent and producing a filtered influent, the membrane filtration unit being disposed in the upper portion of a column reactor over a substantial portion of the fluidized bed such that the influent injected into the bottom of the column reactor moves upward through the fluidized bed and is treated therein prior to reaching the membrane filtration unit;
f. a recirculation line extending exteriorly of the reactor for directing a non-permeated treated water stream from the upper portion of the column reactor into a bottom portion of a column reactor such that the recirculation line is operative to transfer non-permeated treated water from the upper portion of the column reactor, through the exterior recirculation line and into the bottom portion of the column reactor; and
g. an oxidizing gas recirculation line extending exteriorly of a column reactor for transferring oxidizing gas from the upper portion of the column reactor, through the exterior recirculation line and into the bottom portion of the column reactor.

1. The Examiner erred in finding that it would be obvious to place an immersed membrane filter in the Mohri reactor

Both claims 65 and 70 require an immersed membrane filtration unit to be disposed in the upper portion of a column reactor. The Examiner acknowledges that Mohri does not use an immersed membrane filtration unit to filter the influent. Final Office Action, p. 4. The Examiner, however, finds that Rytter teaches the use of a

fluidized bed reactor in which gaseous reactants are bubbled through a slurry containing catalytic material. The Examiner refers to this as a filter. Then the Examiner concludes:

> Therefore, it would have been obvious to a person of ordinary skill in the art at the time of invention to provide a liquid product filter in the bed reactor of Mohri in order to ensure that the catalyst material is retained in the reactor and not drawn off with the product's stream.

Final Office Action, p. 4.

This is error. Mohri goes to lengths to design a system that retains the activated carbon. This is indisputable. Mohri explains that the system should be operated to avoid the activated carbon flying out of the reactor. Mohri describes a method for retaining the catalyst material in the reactor. For example, Mohri states that by using a packing material having a specific pore size prevents the catalyst from flowing out of the reactor. Mohri states the following:

> "The porous packing piece has at least one pore having an average pore diameter 1.5 to 8 times, preferably 2 to 5 times, the average particle diameter of the activated carbon particles. If the average pore diameter of the packing piece is less than 1.5 times, it is difficult for the solid particles to move freely through the pores of the porous packing, and it is impossible to maintain a uniform fluidized state of the solid particles....If the size is more than 8 times, the action of the porous packing to control the motion of the solid particles is reduced, and the fluidized state desired in the present invention cannot be achieved. Consequently, the flowing of the solid particles out of the contacting container cannot be prevented."

Mohri, col. 2 line 66 - col. 3, line 13.

Thus, Mohri explains that by keeping the pore size of the packing material below 8 times that of the average diameter of the activated carbon particles, the activated carbon particles will not flow out of the container. In addition, Mohri describes that by

maintaining the carbon particles at least 5 cm below the packed bed, the carbon particles will not flow out of the reactor. *See*, Mohri, col. 4, lines 11-29.

The Examiner argues that Mohri contemplates that carbon particles can fly out of the contacting container. Here the Examiner refers to the passage in Mohri found at column 4, ll. 25-30. *See* Final Office Action, p. 16. This reference in Mohri simply explains what can happen if one does not correctly follow the Mohri process. Put in context, Mohri teaches:

> The upper level of the activated carbon particles layer should be maintained at least 5 cm., preferably 10 to 20 cm., below the upper level of the porous packed bed. If the upper level of the fluidized activated carbon layer approaches the upper level of the porous packed bed by a distance within 5 cm., or especially when the activated carbon layer is situated above the porous packed bed, the activated carbon particles undesirably fly out of the contacting container.

Mohri, col. 4, ll. 20-29.

The example discussed in Mohri shows that there is no problem with activated carbon flying out of the reactor. In example 3, air was introduced into the container at a rate of 100 liters per hour for a four week period. Mohri observed: "In addition, despite the introduction of air, none of the spherical activated carbon particles were seen to fly out of the container. Mohri, col. 6, ll. 55-57.

The Examiner admits that under ordinary conditions a filter would not be needed. Final Office Action, p. 16. The Examiner speculates that a filter would be helpful if the activated carbon inadvertently reached the outlet. Obviousness cannot be based on speculation nor should obviousness be based on the proposition that through inadvertence a system or process might not work like the inventors intended.

The Examiner has erred in finding that it would be obvious to place an immersed membrane in the Mohri reactor. The technical reasons and rationale advanced by the Examiner for this proposition are unsupported.

2. The Examiner Erred in Further Modifying the Rytter Filter to Include a Membrane Filter.

The Examiner recognizes that Rytter's filter is not a membrane filter. To address this shortcoming of Mohri and Rytter, the Examiner combines Cote. In attempting to state a rational and technical reason for modifying Rytter, the Examiner states:

> Therefore, it would have been obvious to a person of ordinary skill in the art at the time of invention to choose a membrane filter element in the device of Mohri and Rytter in order to retain finally divided activated carbon catalyst.

Final Office Action, p. 5.

This is error. The Rytter filter will retain finally divided activated carbon catalyst. Rytter specifically points out that the average pore size of his filter is 20 microns. Rytter, col. 6, ll. 3-9. Mohri discusses the size of the activated carbon particles that his process utilizes. In particular, Mohri states that the activated carbon particle size ranges from 0.1 mm to 8 mm, and preferably between 0.3 mm and 3 mm. Mohri, col. 3, ll. 62-64. Thus there is no question that the Rytter filter having pores of 20 microns will retain the finally divided activated carbon particles. Thus the reasons articulated by the Examiner for substituting a Cote's membrane filter for the filter of Rytter is totally unsupported. The Examiner erred in making the findings that are advanced to support combining Cote with Mohri and Rytter.

3. The Examiner Erred in Finding That it Would Be Obvious to Move the Rytter Filter From the Middle of the Reactor to the Upper Portion of the Reactor.

The claims call for the immersed membrane filter to be positioned in the upper portion of the reactor. The Examiner acknowledges that Rytter's filter is disposed in the middle of the reactor. The Examiner finds as follows:

> As to the location of the filter within the reactor, Rytter depicts the filter about the middle of the reactor, but a person of ordinary skill in the art at the time of invention would know to place the filter in the upper portion of the reactor, where the reactants, i.e. contaminated water, would have had ample opportunity to contact the catalyst and the oxidizing gas.

Final Office Action, p. 5.

Respectfully, this finding is purely conclusionary and unsupported. It is unsupported because the activated carbon particles in Mohri are confined below the height of L1 shown in Figure 1 of Mohri. See Mohri, col. 5, ll. 18-20. Thus there is no reason to place the filter in the upper portion of Mohri. The Board should note the reason that the Examiner suggested including the Rytter filter. It was to retain the finely divided activated carbon catalyst particles. See Final Office Action, p. 5. If the activated carbon particles are maintained within the L1 region of Mohri, as shown in Figure 1, there is no need to place the filter in the upper portion of the reactor. The Examiner has erred here too.

4. The Examiner Erred in Combining Allen with Mohri, Rytter and Cote.

Paragraphs (h) and (i) of claim 65 call for recirculating at least a portion of the non-permeated treated water from the upper portion of a column reactor, through a

recirculation line that lies outside of the column reactor and back to the lower portion of the column reactor. The Examiner acknowledges that neither Mohri, Rytter, nor Cote show this. However, the Examiner combines the patent to Allen to show a recirculation line. The Examiner concludes:

> Therefore it would have been obvious to a person of ordinary skill in the art at the time of invention to provide a recirculation line in the reactor of Mohri, Rytter and Cote in order to allow for multiple passes of slurry through the reactor, thereby allowing for more complete reaction at high flow volumes.

Final Office Action, p. 5.

The Examiner has erred in making this finding. It is mere speculation to hold that a recirculation line would allow for a more complete reaction at high flow volumes. Apparently the Examiner did not consider the extraordinary success and efficiency of the Mohri process. This can be seen from Example 1, column 6 of Mohri. Here the process reduced COD from 30 ppm to 3 ppm and reduced the oil content from 6 ppm to 0.8 ppm.

These are extraordinary results. There is no reasonable expectation that recycling the non-permeated water in Mohri would provide "for a more complete reaction at high flow volumes." The finding by the Examiner here is merely speculation and conjecture. Furthermore it is difficult to comprehend how simply recycling non-permeated water would improve the results described in Example 1 of Mohri.

5. The Examiner Erred by Combining Bybel with Mohri, Rytter, Cote and Allen

In paragraph (j) of claim 65, for example, the claim calls for recirculating at least a portion of the ozone gas from the upper portion of the column reactor, through a gas recirculation loop disposed outside of the column reactor and back to the lower portion of the column reactor. The Examiner notes that Bybel teaches the recirculation of an oxidizing gas. Then the Examiner concludes:

> It would have been obvious to a person of ordinary skill in the art at the time of invention to reuse the unreacted ozone gas in order to conserve power needed to produce ozone.

Final Office Action, pp. 5-6.

It seems appropriate that if the Examiner is going to make this finding that there should be a prior finding that there is significant unreacted ozone in the Mohri reactor. The Examiner did not make that finding. Of course, if there is insignificant unreacted ozone in Mohri, then there would be no need to recycle or recirculate the same.

CONCLUSION

For the foregoing reasons, the Board is respectfully requested to reverse the Examiner's rejection of the claims in this case.

(VIII.) CLAIMS APPENDIX

28. The method of claim 65 wherein the fluidized bed of catalyst material comprises a solid mineral material having the capacity for adsorbing organic materials, and wherein the method includes directing the influent in the reactor through the solid mineral material and utilizing the solid mineral material to adsorb organic materials from the influent.

29. The method of claim 28 wherein the solid mineral material is doped with metallic substances.

31. The method of claim 65 including selecting the size of particles forming the catalyst material such that the size of the individual particles is of a grading less than 100μm.

32. The method of claim 31 wherein the particle size of the catalyst material has a size grading between about 10nm and about 40μm.

33. The method of claim 65 wherein the catalyst material is selected from the group comprising alumina, titanium, coal, activated carbon, polymetallic oxides, and derivatives thereof.

34. The method of claim 65 wherein directing the treated water through the membrane filtration unit comprises directing the treated water through one or more microfiltration membranes.

35. The method of claim 65 wherein directing the treated water through the membrane filtration unit comprises directing the treated water through one or more ultrafiltration membranes.

36. The method of claim 65 wherein directing the treated water through the membrane filtration unit comprises directing the treated water through one or more nanofiltration membranes.

37. The method of claim 65 wherein directing the treated water through the membrane filtration unit includes directing the treated water through a mineral filtration unit.

38. The method of claim 65 wherein directing the treated water through the membrane filtration unit includes directing the treated water through an organic filtration unit.

40. The method of claim 65 wherein the oxidizing gas comprises at least one oxidant taken from the group including air, ozone, ozoned air, nitrogen oxide, oxygen, and derivatives thereof.

41. The method of claim 65 including adding H_2O_2 into the reactor.

44. The method of claim 65 wherein the influent is not subjected to mechanical stirring within the reactor.

45. The method of claim 65 including contacting the influent with the catalyst material for a period of about 5 minutes to about 3 hours.

46. The method of claim 45 including contacting the influent with the catalyst material for a period of about 30 minutes to about 60 minutes.

47. The method of claim 65 including providing a suction source disposed external to the reactor and operatively connecting the suction source to the membrane filtration unit for inducing filtered effluent from the filtration membrane unit and from the reactor.

48. The method of claim 47 wherein the suction includes a pressure of less than 1 bar.

49. The method of claim 47 wherein the suction includes a pressure is between 0.1 bars and 0.8 bars.

55. The system of claim 70 wherein the catalyst material comprises a solid mineral material having the capacity for adsorbing organic materials.

57. The system of claim 55 wherein the bed of catalyst material includes particles and wherein the size of the particles is of a grading less than 100 μm.

59. The system of claim 70 wherein the catalyst material has a concentration of approximately 0.5 g/l and 50 g/l in the reactor.

60. The system of claim 70 wherein the catalyst material is boehmite alumina which has been calcined at a temperature of less than 600°C

61. The system of claim 60 wherein the boehmite alumnia is enriched in metallic substances.

62. The system of claim 70 wherein the catalyst material has a diameter of less than approximately 50μm.

63. The system of claim 62 wherein the catalyst material has a diameter of approximately 30μm.

64. The system of claim 70 wherein the membrane filtration unit includes a plurality of membranes and wherein the type of membranes disposed therein is based on a dimension of the catalyst material.

65. A method of treating an aqueous influent containing organic matter, the method comprising:

a. injecting an oxidizing gas into a bottom portion of a vertical oriented column reactor;

b. suspending a bed of catalyst material in the column reactor to form a fluidized bed of catalyst material in the reactor wherein at least a portion of the fluidized bed is disposed in the lower portion of the column reactor;

c. wherein the oxidizing gas injected into the column reactor functions to suspend the bed of catalyst material in the reactor;

d. injecting the influent to be treated into the bottom portion of the column reactor where the influent is contacted with the oxidizing gas in the presence of the fluidized bed of catalyst material that promotes the oxidation reaction of organic material in the influent or promotes the adsorption of organic material by the bed of catalyst material thereby yielding treated water;

e. wherein the column reactor includes an immersed membrane filtration unit disposed in the upper portion of the column reactor and where in at least a portion of the fluidized bed of catalyst material is maintained below the membrane filtration unit in the column reactor;

f. after directing the influent through the fluidized bed of catalyst material and oxidizing gas in the lower portion of the column reactor, filtering at least a first portion of the treated water in the immersed membrane filtration unit disposed in the upper portion of the column reactor forming a filtered influent;

g. directing the filtered influent from the reactor;

h. bypassing the immersed membrane filtration unit with at least a second portion of the treated water such that the second portion of the treated water is non-permeated treated water;

i. recirculating at least a portion of the non-permeated treated water from the upper portion of the column reactor, through a recirculation line that lies outside of the column reactor and back into the lower portion of the column reactor; and

j. recirculating at least a portion of the oxidizing gas from the upper portion of the column reactor, through a gas recirculation loop disposed outside of the column reactor and back into the lower portion of the column reactor.

66. The method of claim 65 including forming at least some of the catalyst material on the surfaces of the membrane filtration unit, and directing at least some of the

influent through the catalyst material formed on the surface of the membrane filtration unit.

67. The method of claim 65 wherein the membrane filtration unit includes a series of membranes and the method includes utilizing the oxidizing the gas to:

i. promote the oxidation reaction of organic material in the influent;

ii. suspend the catalyst material in the column reactor to form the fluidized bed; and

iii. limit clogging of the membranes of the membrane filtration unit due to the mechanical action of the oxidizing gas on the membranes which in turn improves the flow of treated water through the membranes.

68. The method of claim 67 wherein oxidation of the influent and filtration by the membrane filtration unit both occur in a single chamber formed by the column reactor.

69. The method of claim 68 wherein the catalyst material is boehmite alumina.

70. A system for oxidizing and filtering an aqueous influent containing organic matter, the system in operation comprising:

a. a single chamber column reactor oriented in a vertical configuration and having a bottom portion and an upper portion;

b. an influent inlet formed in the bottom portion of the column reactor for permitting the influent to enter the bottom portion of the column reactor;

c. a fluid bed of catalyst material disposed in the column reactor and wherein a substantial portion of the fluid bed of catalyst material is disposed in the lower portion of the column reactor;

d. an oxidizing gas inlet formed in the bottom portion of the column reactor for injecting an oxidizing gas into the bottom portion of the column reactor and for oxidizing the organic material in the influent and for suspending the catalyst material in the column reactor and forming the fluidized bed of catalyst material;

e. a membrane filtration unit for filtering the treated influent and producing a filtered influent, the membrane filtration unit being disposed in the upper portion of a column reactor over a substantial portion of the fluidized bed such that the influent injected into the bottom of the column reactor moves upward through the fluidized bed and is treated therein prior to reaching the membrane filtration unit;

f. a recirculation line extending exteriorly of the reactor for directing a non-permeated treated water stream from the upper portion of the column reactor into a bottom portion of a column reactor such that the recirculation line is operative to transfer non-permeated treated water from the upper portion of the column reactor, through the exterior recirculation line and into the bottom portion of the column reactor; and

g. an oxidizing gas recirculation line extending exteriorly of a column reactor for transferring oxidizing gas from the upper portion of the column reactor,

through the exterior recirculation line and into the bottom portion of the column reactor.

(IX.) EVIDENCE APPENDIX

None.

(X.) RELATED PROCEEDINGS APPENDIX

There are no related proceedings.

Respectfully submitted,

COATS & BENNETT, P.L.L.C.

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